

[54] **SLIDING ROOF FOR VEHICLES**

[75] **Inventor:** Toshiaki Niwa, Saitama, Japan

[73] **Assignee:** Honda Giken Kogyo Kabushiki Kaisha, Tokyo, Japan

[21] **Appl. No.:** 827,874

[22] **Filed:** Feb. 10, 1986

Related U.S. Application Data

[62] Division of Ser. No. 510,336, Jul. 1, 1983, abandoned.

[30] **Foreign Application Priority Data**

Jul. 2, 1982 [JP] Japan 57-115271

[51] **Int. Cl.⁴** B60J 7/047; B60J 7/057

[52] **U.S. Cl.** 296/216; 296/220; 296/223

[58] **Field of Search** 296/216, 220, 221-223

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,407,541 10/1983 Boots 296/216
4,463,983 8/1984 Hellriegel 296/216

FOREIGN PATENT DOCUMENTS

2068304 8/1981 United Kingdom 296/216

Primary Examiner—Robert B. Reeves

Assistant Examiner—Dennis H. Pedder

Attorney, Agent, or Firm—Irving M. Weiner; Joseph P. Carrier; Pamela S. Burt

[57] **ABSTRACT**

A sliding roof in which a panel for closing and opening a roof opening is supported with front and rear stays slidable through guide means arranged on both sides of the opening. Portions of the guide means, supporting at least the rear stays, have front ends thereof hinged to a frame defining the opening and rear ends thereof being liftable, whereby the rear stays become elevated when the rear ends of the portions are lifted. Also, each of the rear stays has a rearwardly extending section which, when the sliding roof panel has been completely moved rearwardly, is located over a section of the vehicle roof adjacent a rear edge of the opening.

23 Claims, 19 Drawing Figures

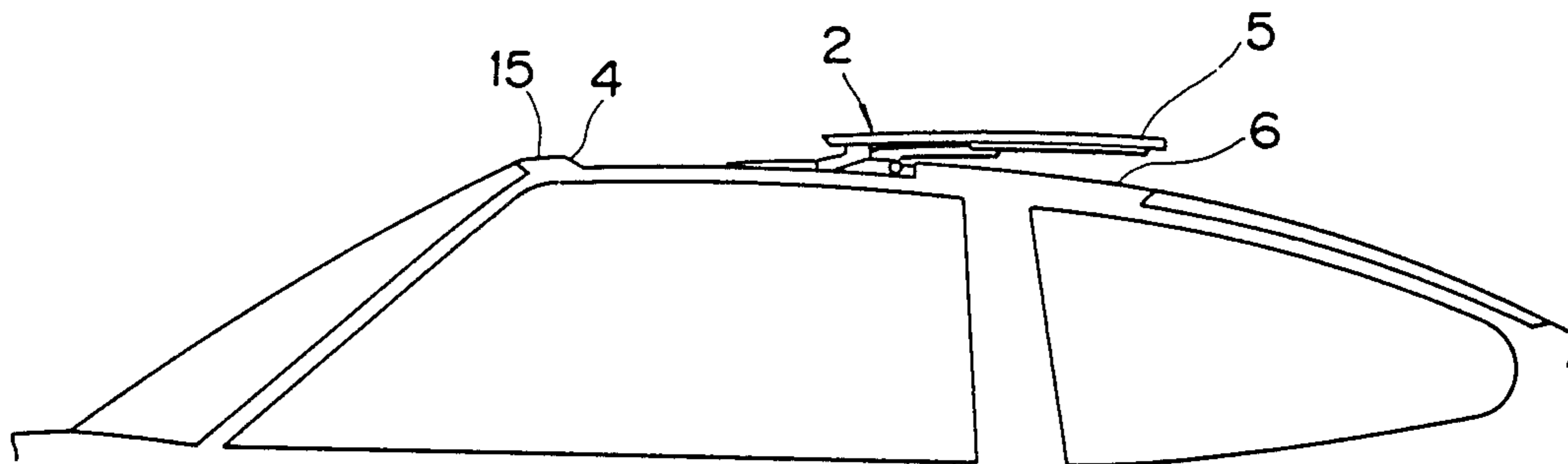


FIG. 1

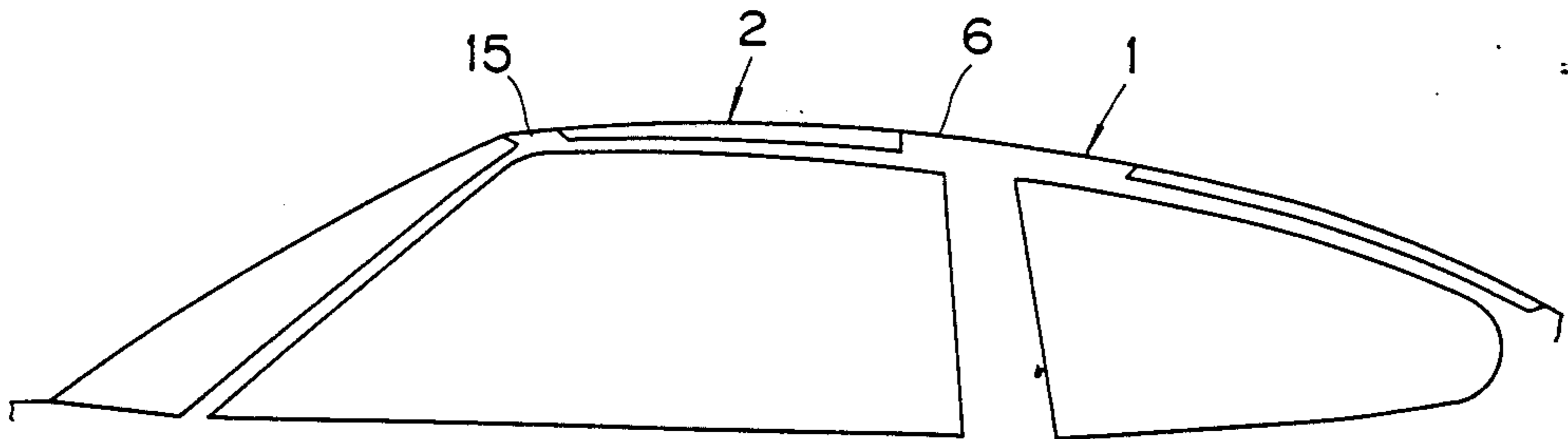


FIG. 2

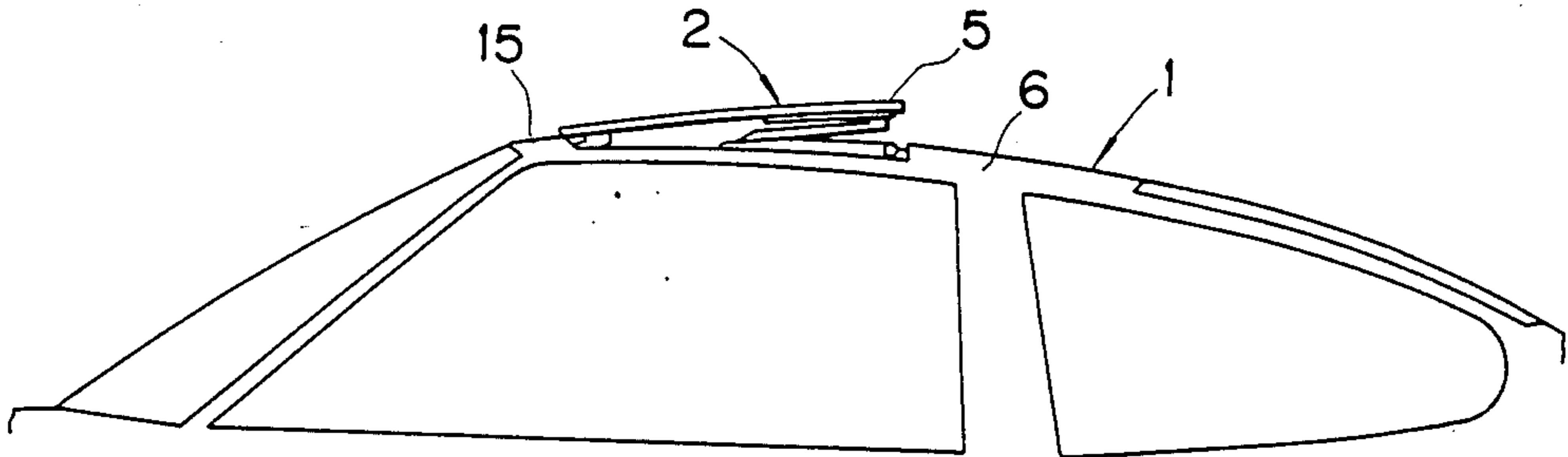
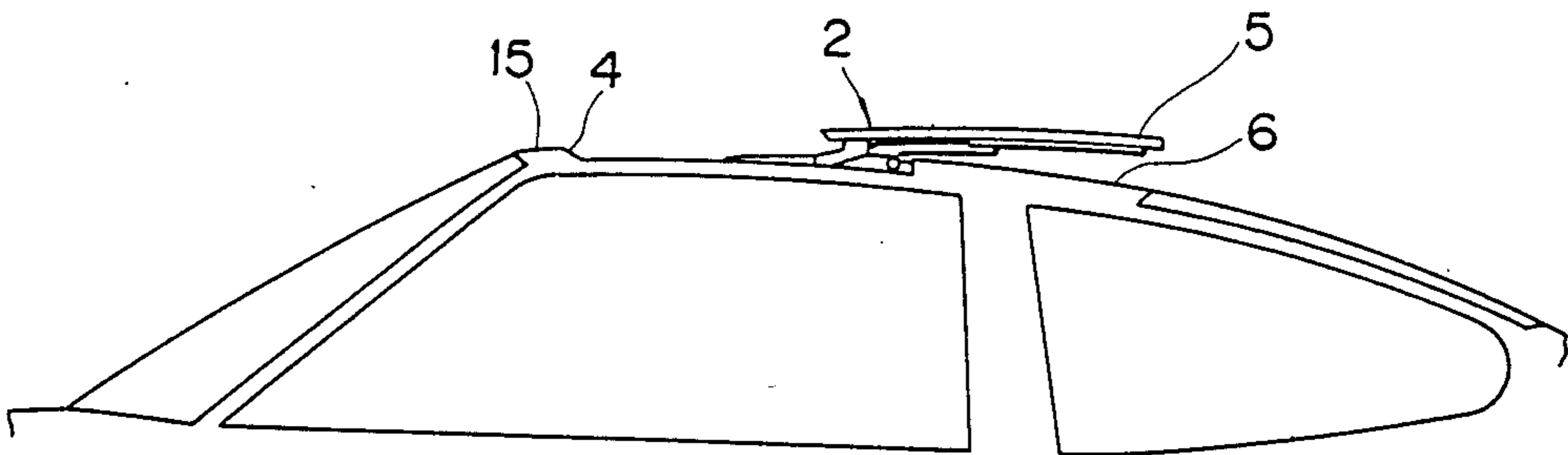


FIG. 3



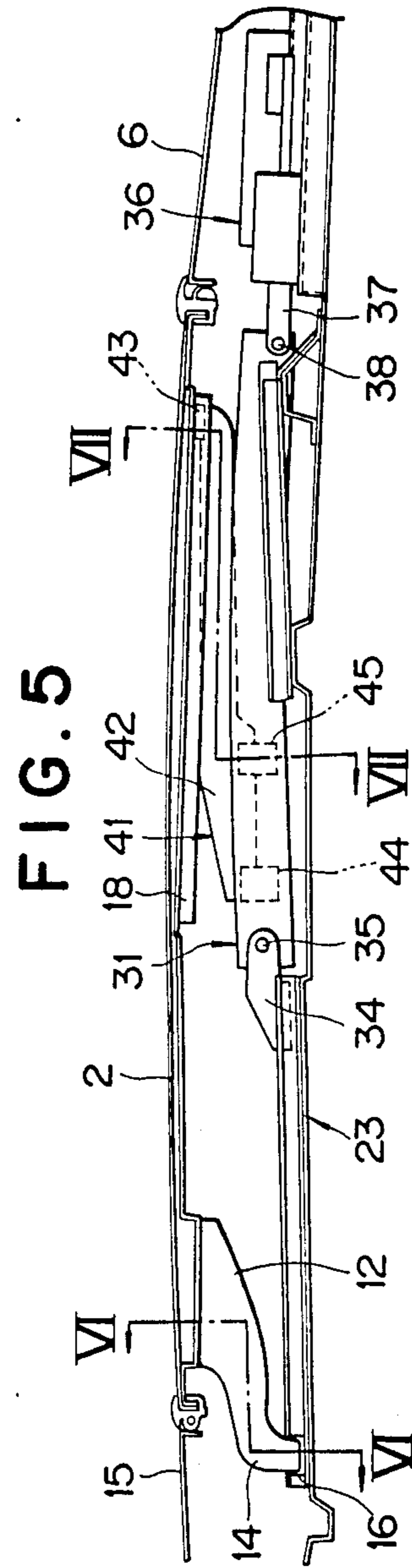
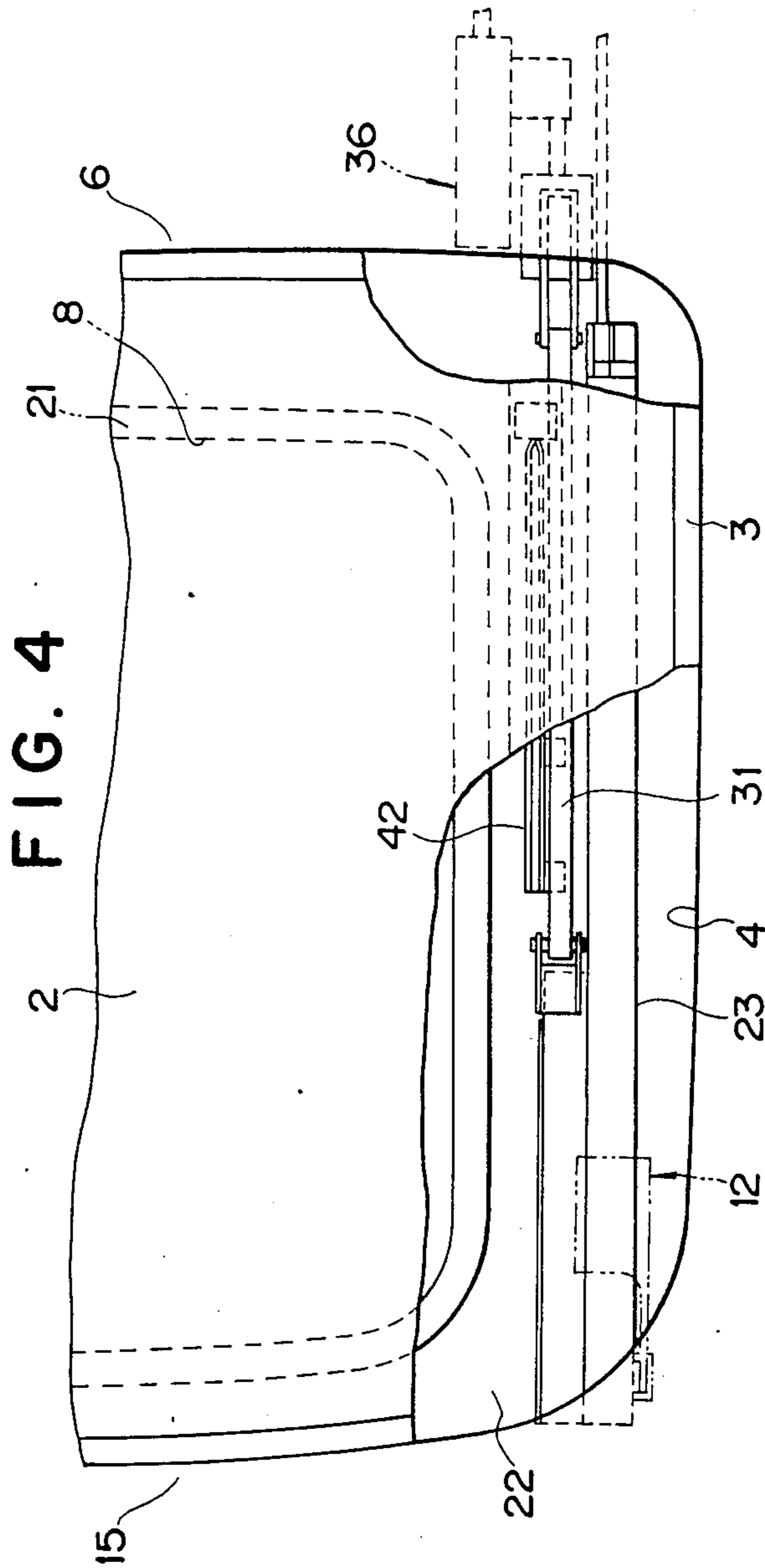


FIG. 6

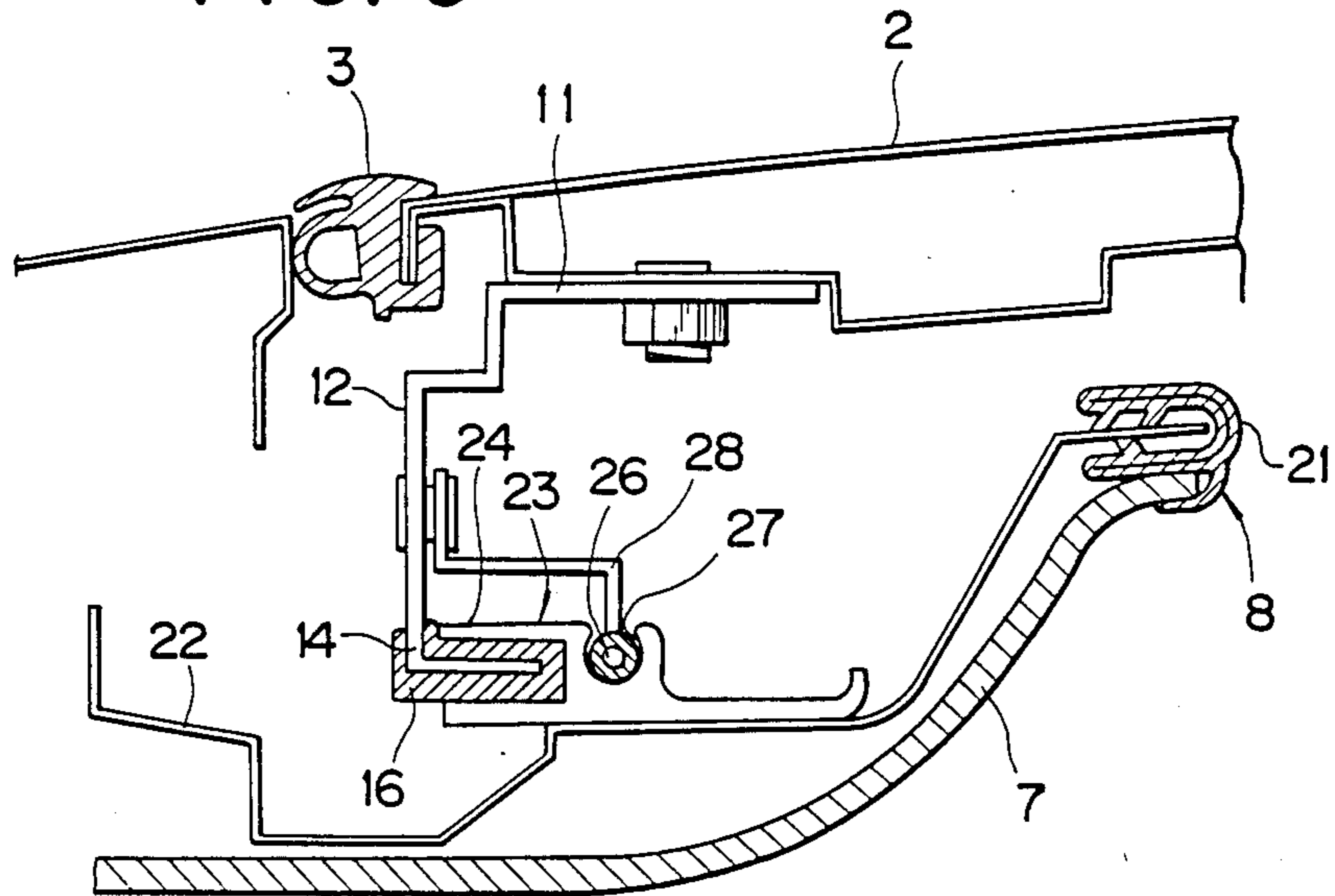
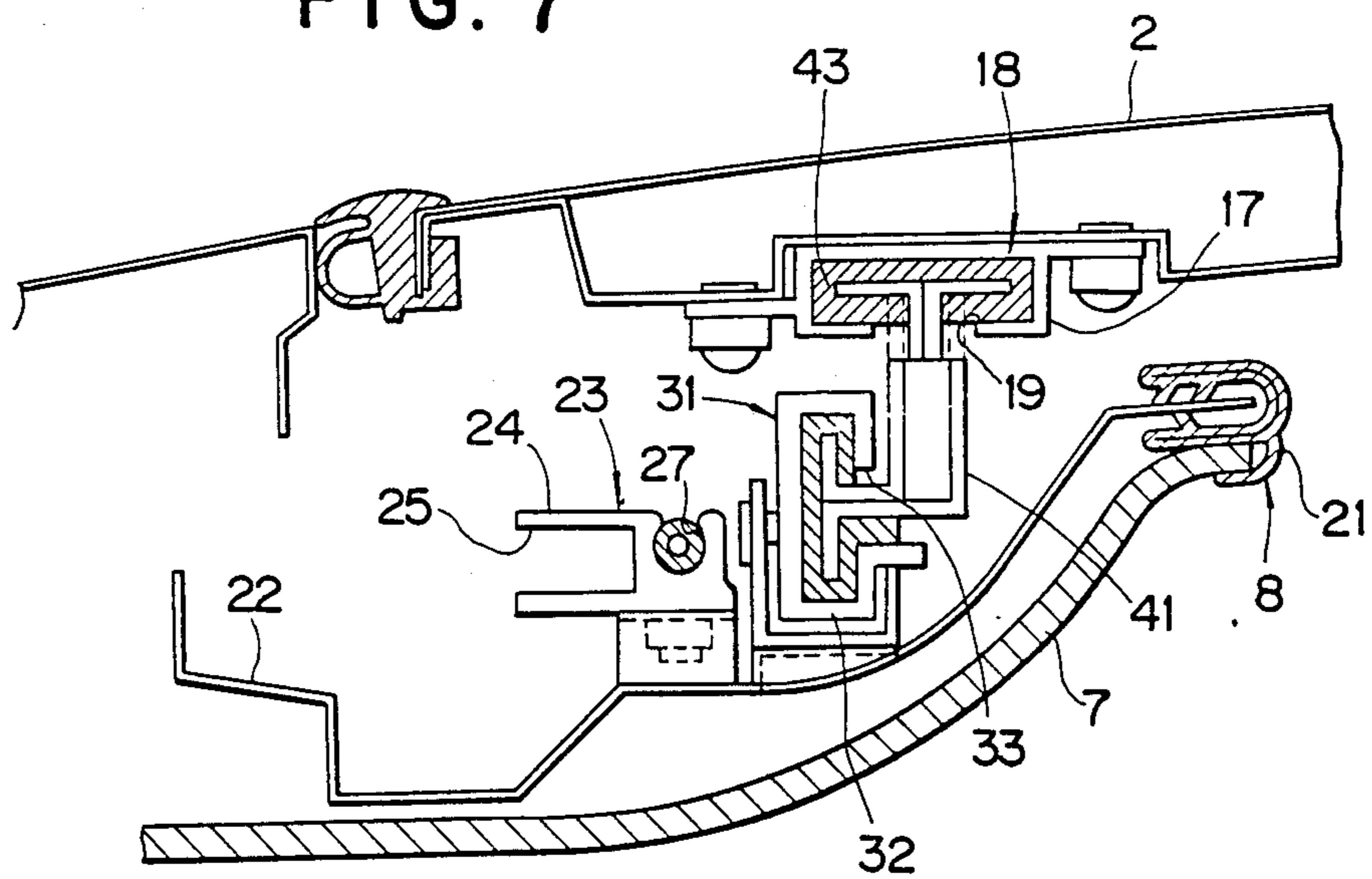


FIG. 7



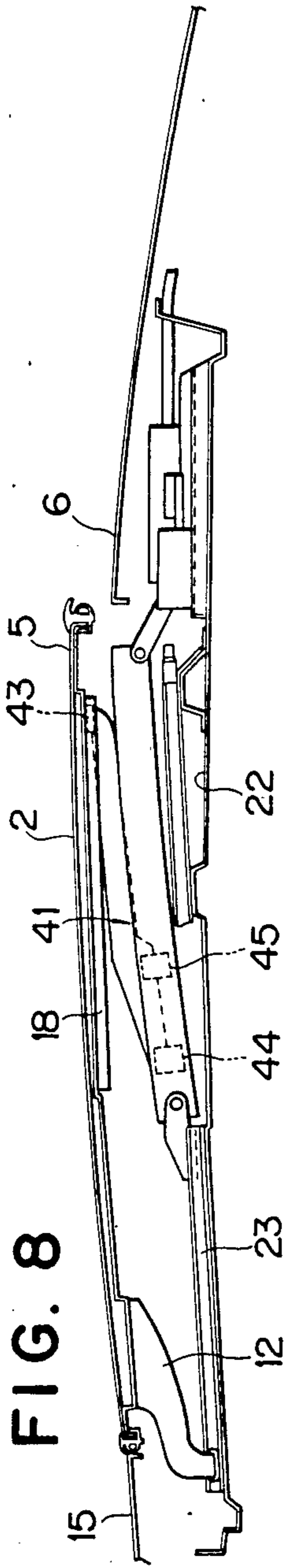


FIG. 8

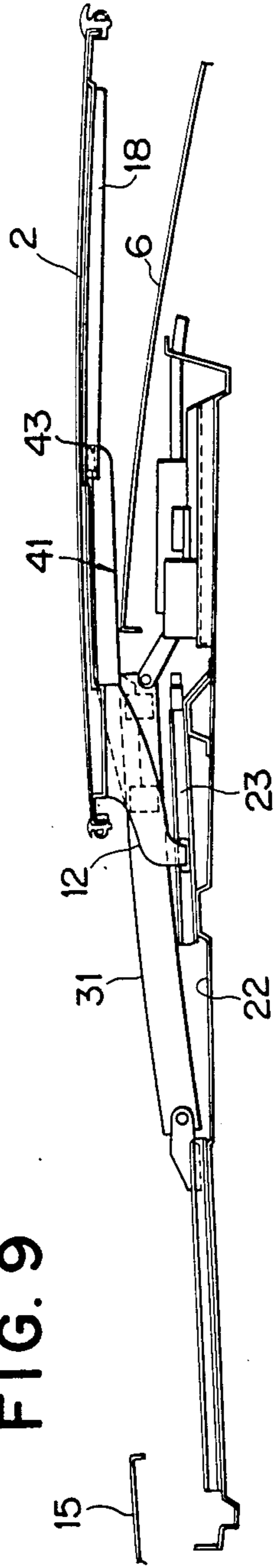


FIG. 9

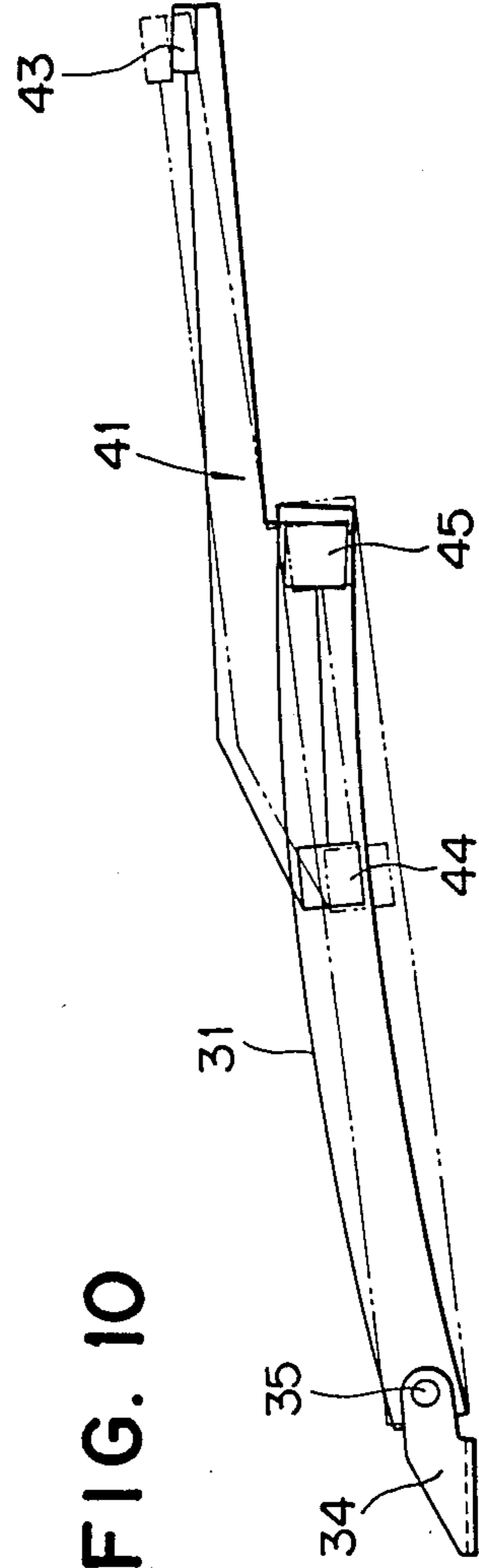


FIG. 10

FIG. 11

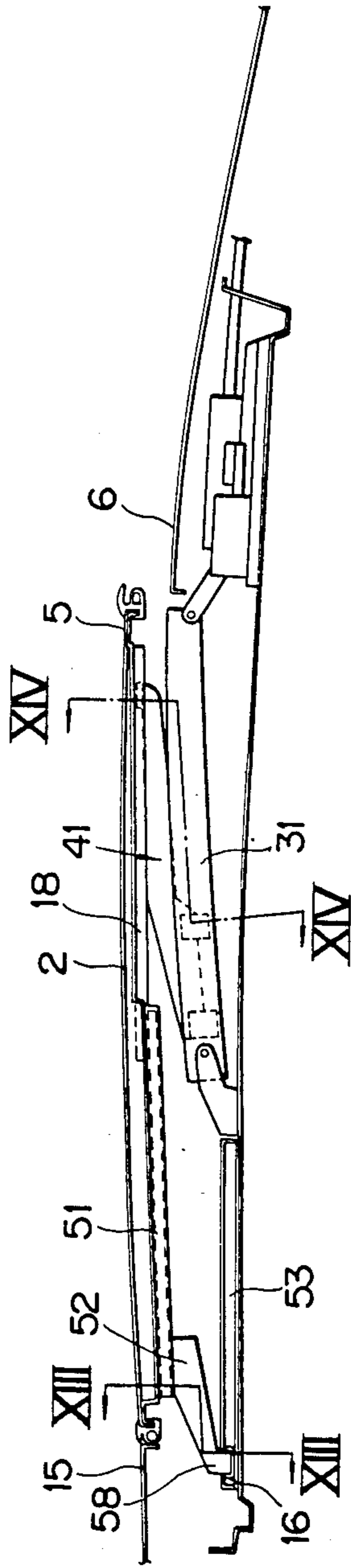


FIG. 12

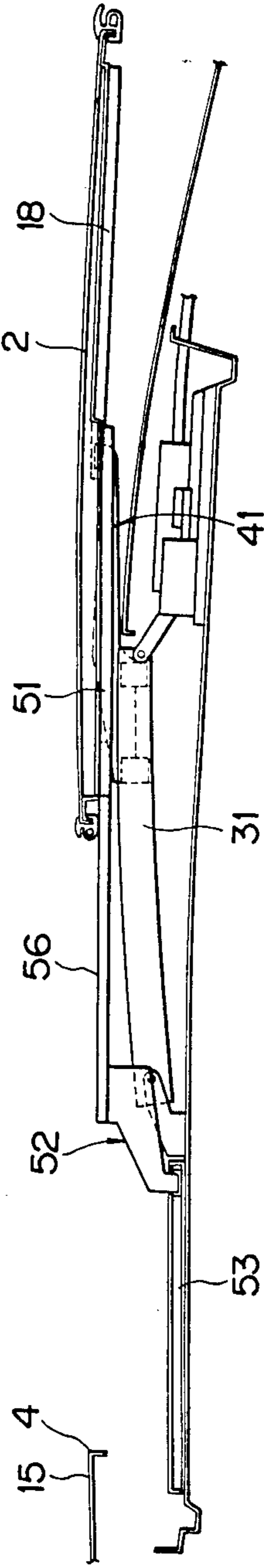


FIG. 13

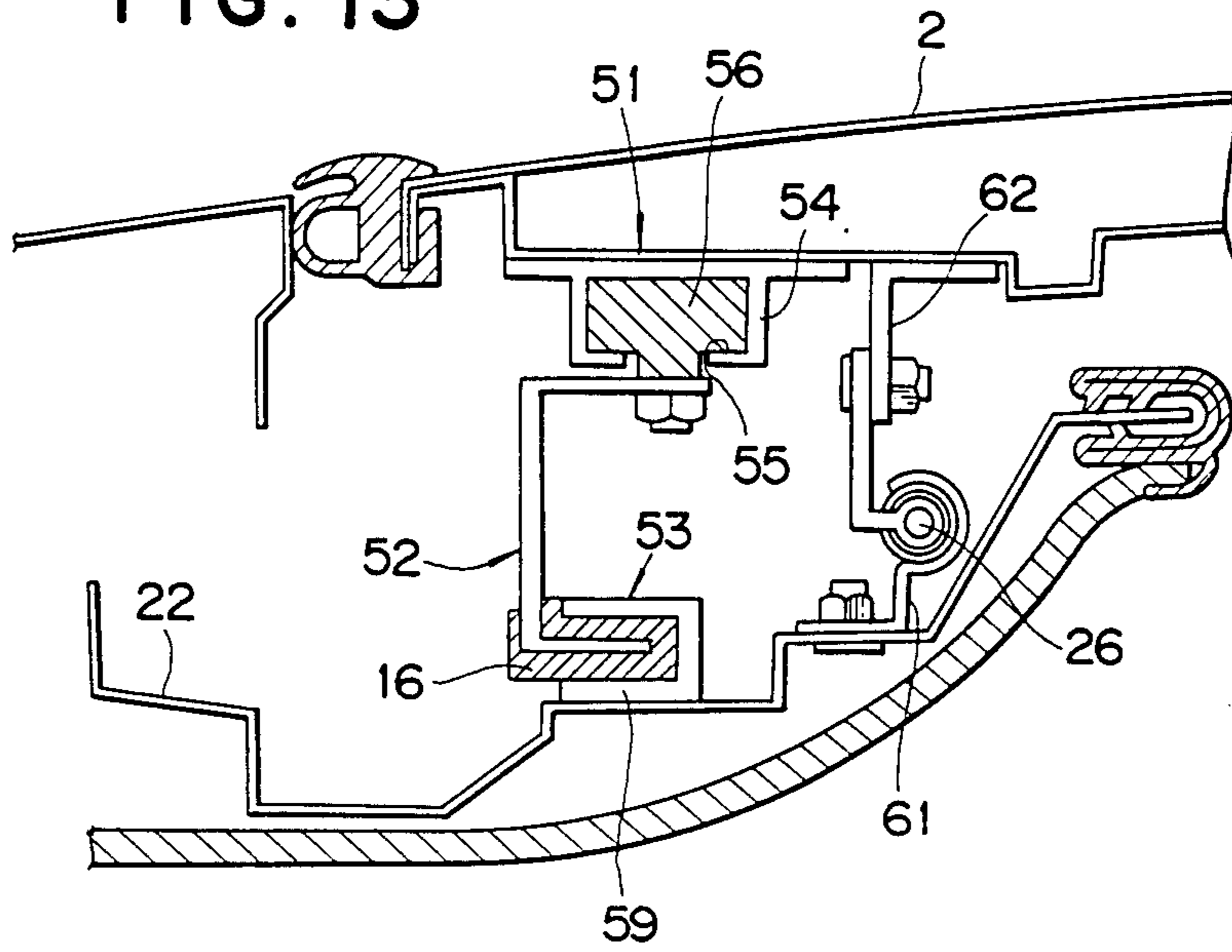


FIG. 14

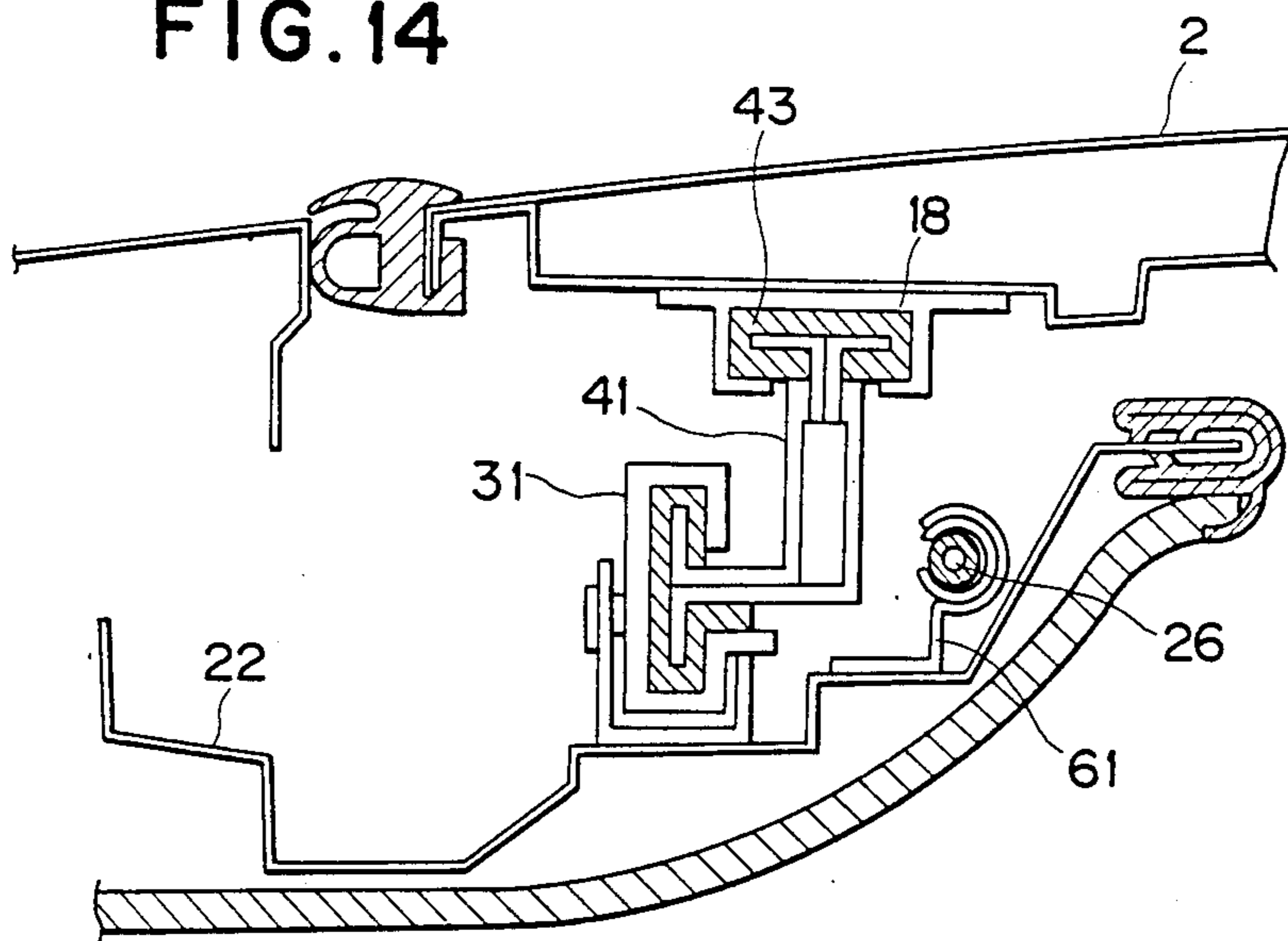


FIG. 15

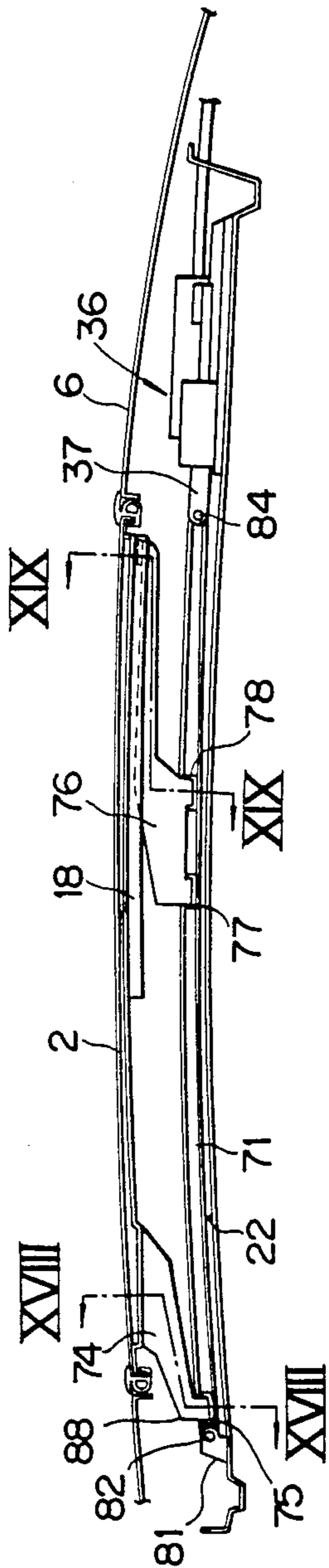


FIG. 16

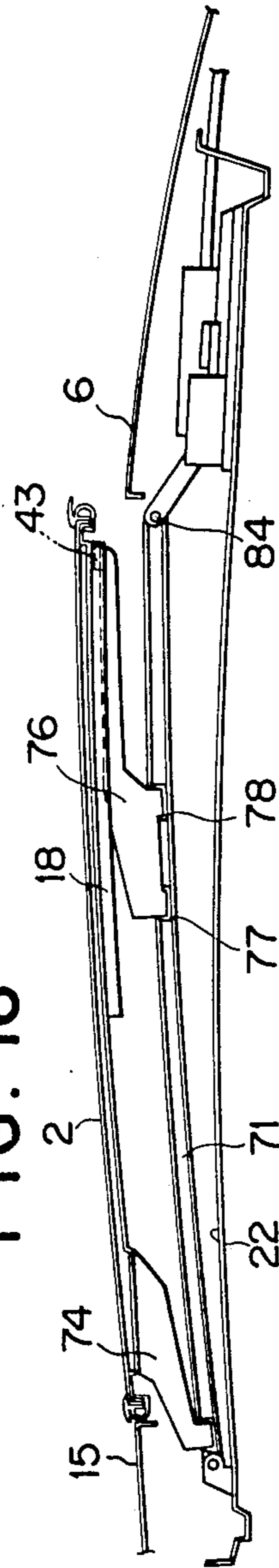


FIG. 17

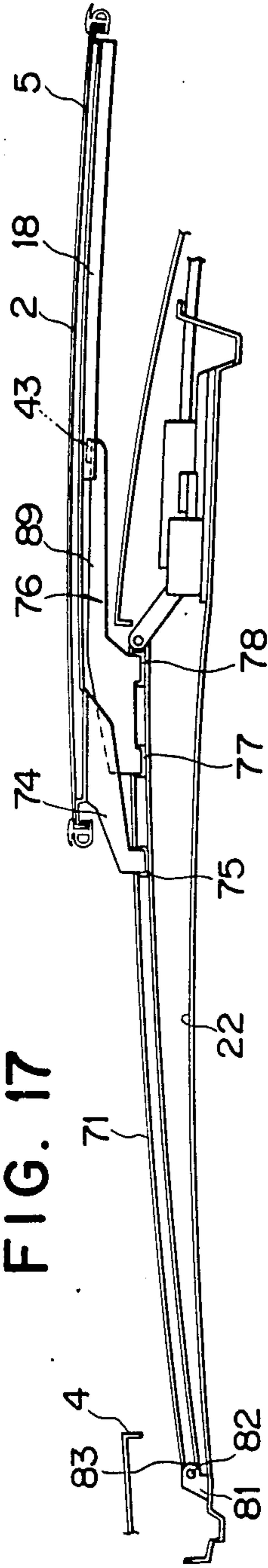


FIG. 18

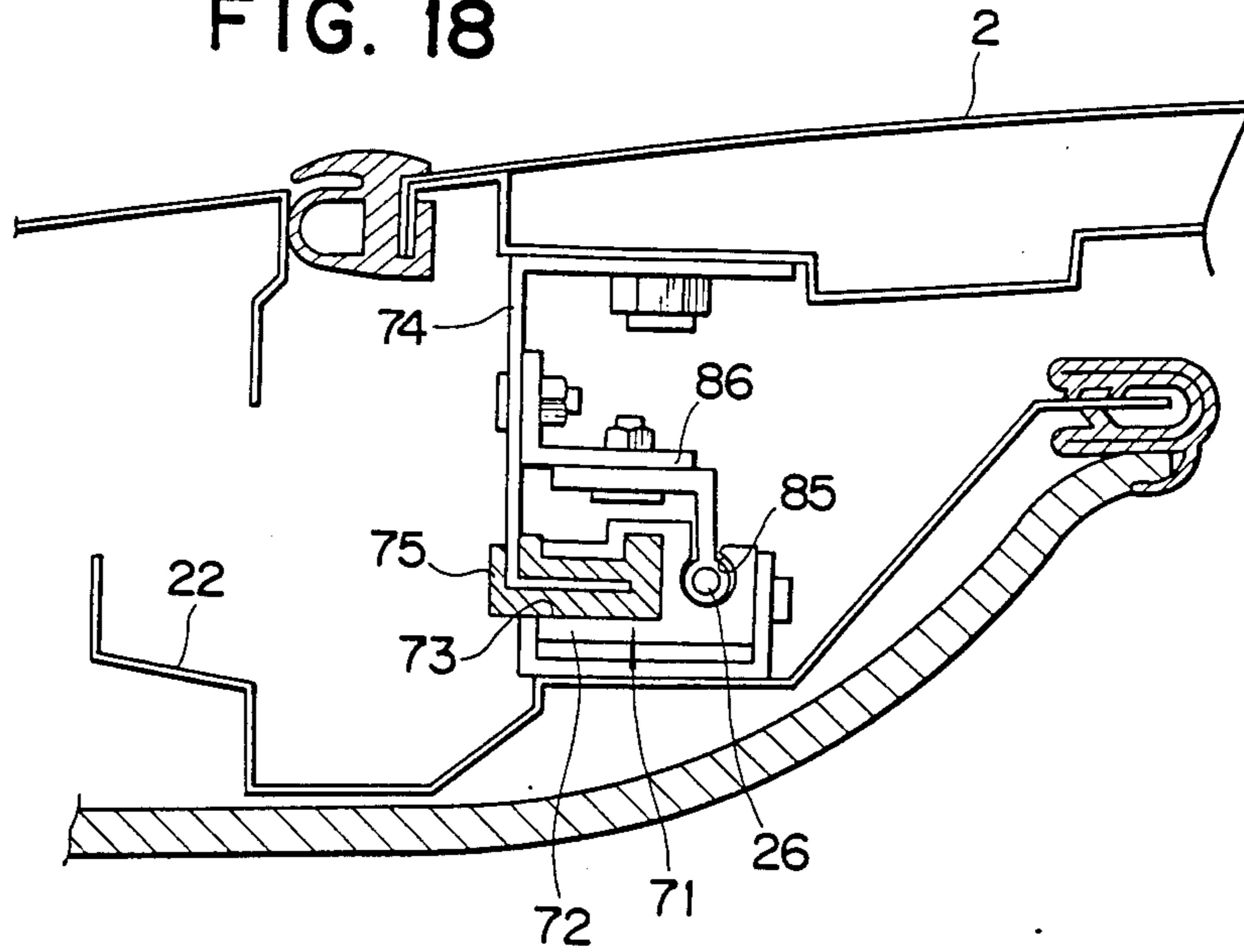
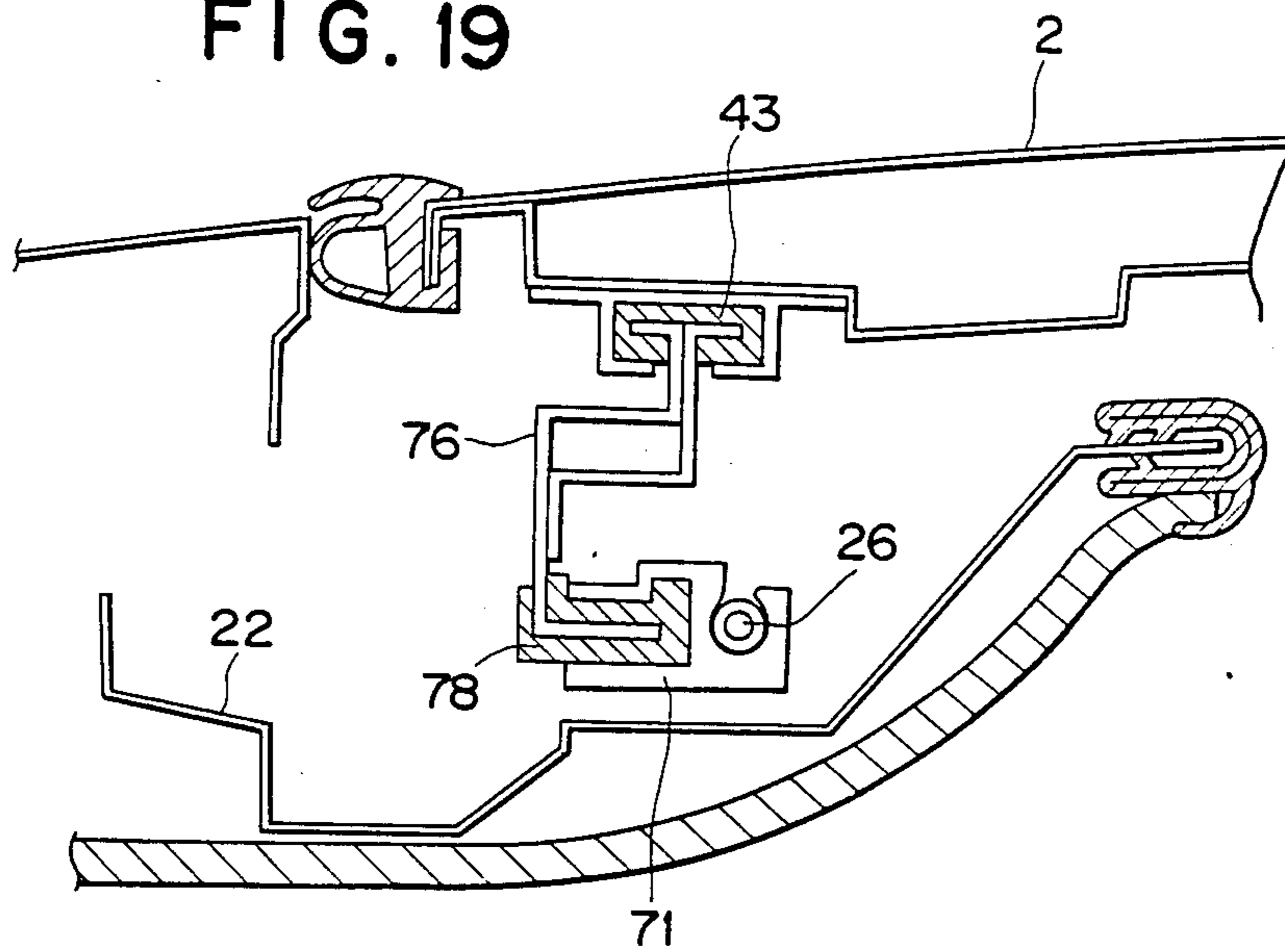


FIG. 19



SLIDING ROOF FOR VEHICLES

This is a divisional of application Ser. No. 510,336 filed July 1, 1983, abandoned, now FWC Ser. No. 890,975 filed July 30, 1986.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a sliding roof for vehicles. Particularly, the invention relates to a sliding roof for vehicles of the type in which a slidable panel slides outwardly and rearwardly of a roof opening.

2. Description of Relevant Art

As one of the sliding roofs for vehicles, there has been known in the art an externally sliding roof which is disclosed in GB No. 2,068,304. The externally sliding roof is provided with: an opening formed in a body roof; a panel adapted to open and close the opening; and a guide for guiding the opening and closing movement of the panel on the roof so that the panel is slid above the roof through said guide to open the opening.

In that sliding roof, however, the member for supporting the rear part of the sliding roof panel, i.e., the screw telescope merely extends and contracts in the vertical directions at the rear part of the opening of the roof so that it supports only the front part of said panel when said panel is in its rearmost moved position. As a result, the panel rear part is finely vibrated up and down by the vibrations of a running vehicle so that the panel cannot be said to have a high supporting stability.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a sliding roof for vehicles, comprising an opening formed in a body roof; a panel adapted to open and close said opening; a guide for guiding the opening and closing movements of said panel above the roof; a tilt-up mechanism for tilting up the rear portion of the guide; and stays interposed between said guide and said panel so that said stays have their body side fulcrum positioned beneath the roof opening and their panel side fulcrum positioned above the same when said panel is opened.

Accordingly, an object of the present invention is to provide a sliding roof for vehicles, which is enabled to enhance the supporting stability of the panel when the panel is opened.

The above and further features and objects of the present invention will become more fully apparent from the following detailed description of the preferred embodiments of the invention when the same is read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

FIG. 1 is a schematic side view of an upper portion of a vehicle provided with a sliding roof according to the invention, with a slidable panel closed.

FIG. 2 is a view similar to FIG. 1, with the slidable panel raised at the rear part thereof.

FIG. 3 is a view similar to FIG. 1, with the slidable panel moved to the rear stroke end thereof.

FIG. 4 is a partial plan view of the sliding roof in accordance with a first embodiment of the invention, with the slidable panel partially broken away.

FIG. 5 is a sectional view of the embodiment of FIG. 4, with the slidable panel closed.

FIG. 6 is a sectional view taken along line VI—VI of FIG. 5.

FIG. 7 is a sectional view taken along line VII—VII of FIG. 5.

FIG. 8 is a sectional view similar to FIG. 5, with the slidable panel raised at the rear part thereof.

FIG. 9 is a sectional view similar to FIGS. 5 and 8, with the slidable panel moved to the rear stroke end thereof.

FIG. 10 is an explicative view of the functional relation between a rear slide stay and a guide rail therefor.

FIGS. 11 and 12 are sectional views of the sliding roof in accordance with a second embodiment of the invention, with the slidable panel raised at the rear part thereof and moved to the rear stroke end thereof, respectively.

FIGS. 13 and 14 are sectional views taken along lines XIII—XIII and XIV—XIV of FIG. 11, respectively.

FIGS. 15, 16 and 17 are sectional views of the sliding roof in accordance with a third embodiment of the invention, with the slidable panel closed, raised at the rear part thereof and moved to the rear stroke end thereof, respectively.

FIGS. 18 and 19 are sectional views taken along lines XVIII—XVIII and XIX—XIX of FIG. 15, respectively.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIGS. 1 to 4, designated by reference numeral 1 is a roof of a vehicle. The roof 1 is formed therethrough with an opening 4 closable with a slidable panel 2 which has along the peripheral edge thereof a seal member 3 fitted thereon. To open the roof opening 4, the panel 2 is raised at its rear part 5 (FIG. 2) and moved toward the rearmost position of a rear fixed roof 6 of the vehicle (FIG. 3). At this time, an opening 8 (FIG. 4) formed through a lining 7 of the roof 1 is concurrently opened, permitting a passenger area of the vehicle to communicate with the open air through the openings 4 and 8.

Referring now to FIGS. 5 and 6, on both sides of the front end of the underside surface of the panel 2, there is provided either of a pair of front stays 12 depending downwardly therefrom while having their flanged upper ends 11 secured to the panel 2 and their lower ends 14 provided with either of a pair of sliders 16. Each front stay 12 has a form extending, between the flanged upper end 11 to the lower end 14, forwardly relative to the body of the vehicle and projecting, at the lower end 14, forwardly of the front part of the panel 2 so that, while the panel 2 is in its closed position, the lower end 14 is disposed under a front fixed roof 15 of the vehicle.

As shown in FIGS. 5 and 7, the panel 2 is provided on the underside surface thereof, along its portion extending rearwardly from the intermediate part thereof, with a pair of sub-guide rails 18 disposed respectively on both sides thereof, the sub-guide rails 18 being each formed with a guide slot 19 opened downwardly.

The opening 8 in the roof lining 7 is provided around the peripheral edge thereof with a trim member 21 fitted thereon and, over the roof lining 7, there are disposed a pair of sheet-like frame members 22 having their inner ends held by the trim member 21, the frame members 22 being disposed under respective sides of the panel 2.

On the frame members 22, there is fixed either of a pair of main guide rails 23 extending in a straight manner from the front part of the roof opening 4 to the rear part thereof. Each main guide rail 23 has a guide portion 24 shaped in its section in the form of a channel defining a groove 25 directed transversely outwardly of the vehicle body and is extended at the front end part thereof to underlie the front fixed roof 15, while being forwardly inclined as a whole with the rear part thereof positioned at a higher level than the front part thereof. In other words, the guide rail 23 is rearwardly inclined upwardly. The guide portion 24 of each main guide rail 23 is formed in its transversely inward portion with a guide slot 27 for slidably guiding a drive cable 26 which is connected through a fitting 28 to the front stay 12, as shown in FIG. 6.

In the guide portion 24 of each main guide rail 23, there is fitted a slider 16 which is adapted to be slidable therealong and rotatable for a predetermined angle range to thereby cause the panel 2 to be tilted up or raised at the rear part 5. As shown in FIGS. 8 and 9, the panel 2 is adapted to be slidable with the front stay 12 over the rear fixed roof 6 when the drive cable 26 is moved rearwardly from the state thereof as the panel 2 is raised at the rear part 5. In the fully closed state of the panel 2 shown in FIG. 5, the lower end 14 of the front stay 12 is located under the front fixed roof 15 and the slider 16 is at the front end part of the main guide rail 23, while in a fully opened state thereof shown in FIG. 9 the slider 16 is brought near the rear end part of the main guide rail 23.

On each frame member 22, at the transversely inward side of the guide portion 24 of the main guide rail 23, there is mounted a sub-guide rail 31 at the side of the frame member 22 corresponding to the sub-guide rail 18 at the side of the panel 2, the sub-guide rail 31 extending between a substantially intermediate part thereof.

The frame side sub-guide rail 31 has a guide portion 32 formed therein with a slot 33 opened inwardly of the vehicle body and, as shown in FIG. 5, is pivotably connected at the front end part thereof to a support shaft 35, which is supported by a hinge arm 34 secured to the substantially intermediate part of the frame member 22 at either transverse side thereof, and at the rear end part thereof through a support shaft 38 to a drive lever 37 of a tilt-up mechanism 36, which is disposed under the rear fixed roof 6 at either transverse side thereof.

As shown in FIG. 10, the sub-guide rail 31 is arcuately formed to be slightly convexed upwardly, and adapted to be vertically swingable about the shaft 35, following the drive lever 37, when lever 37 is vertically rotated with tilt-up mechanism 36.

Between the panel side sub-guide rail 18 and the frame side sub-guide rail 31, there is slidably fitted a rear stay 41 extending longitudinally of the vehicle body, the rear stay 41 being provided on the upper side of the rear part thereof with a slider 43 slidably fitted in a guide portion 17 of the panel side sub-guide rail 18 and on the lower side of the front part thereof with a pair of sliders 44, 45 spaced from each other longitudinally of the vehicle body and both slidably fitted in the guide portion 32 of the frame side sub-guide rail 31, while the vertical distance between the upper slider 43 and the lower sliders 44, 45, that is the height of the rear stay 41, is predetermined to be smaller than that between the slider 16 and the panel 2, that is, the height of the front stay 12.

In the fully closed state of the panel 2 shown in FIG. 5, the upper slider 43 is located in the rear end part of the panel side sub-guide rail 18 and the lower front slider 44 is located in the front end part of the frame side sub-guide rail 31. In the fully opened state of the panel 2 shown in FIG. 9, in which the rear stay 41 is brought over the rear fixed roof 6, the upper slider 43 is positioned in the front end part of the panel side sub-guide rail 18 and the lower rear slider 45 is positioned in the rear end part of the frame side sub-guide rail 31.

In the above arrangement, the sliders 43, 44, 45 and the guide portions 17, 32 are so arranged that, with the longitudinal movement of the panel 2, the rear stay 41 also moves longitudinally of the vehicle body. Namely, the rearward movement of the rear stay 41 may be such that at first only the panel 2 moves rearwardly from the state shown in FIG. 8 and in due course the panel side sub-guide rail 18 engages at the front end part thereof with the upper slider 43 before the rear stay 41 starts moving rearwardly integrally with the panel 2, or such that the rear stay 41 moves rearwardly integrally with the panel 2 from the initial point and in due course the lower rear slider 45 engages with the rear end part of the frame side sub-guide rail 31 before the upper slider 43 slides along the panel side sub-guide rail 18, thereby permitting only the panel 2 to move rearwardly. Moreover, the rear stay 41 may move rearwardly, sequentially following the rearward movement of the panel 2.

There will be described hereinbelow the function and effect of the sliding roof in accordance with the first embodiment of the invention.

First of all, to fully open the panel 2, when from the fully closed state of the panel 2 shown in FIGS. 1 and 5 the drive lever 37 is driven to turn upwardly with the tilt-up mechanism 36, the frame side sub-guide rail 31 will swing upwardly about the support shaft 35 as a fulcrum, thereby causing the rear part 5 of the panel 2 to be tilted up or raised with the rear stay 41, whereas the tilt-up action of the rear part 5 of the panel 2 is rendered smooth with the slider 16 fixed to the front stay 12, which slider 16 is fitted in the guide portion 24 of the main guide rail 23 so as to be rotatable for the predetermined angle range as mentioned hereinabove.

Then, when a cable actuator (not shown) is operated to have the drive cable 26 move rearwardly, the rearward movement of the drive cable 26 will be transmitted through the front stay 12 to the panel 2, thereby causing the slider 16 fixed to the front stay 12, the slider 43 fixed to the rear part of the rear stay 41 and the sliders 44, 45 fixed to the front part of the rear stay 41 to slide along the guide portion 24 of the main guide rail 23, the guide portion 17 of the panel side sub-guide rail 18 and the guide portion 32 of the frame side sub-guide rail 31, respectively, thus carrying the panel 2 toward the rear fixed roof 6.

As the panel 2 moves rearwardly, the rear stay 41 will also move rearwardly, while with the rearward movement of the rear stay 41, the height of which is predetermined to be less than the height of the front stay 12 in addition to that the frame side sub-guide rail 31 is arcuately formed to be slightly convexed upwardly, the inclination of the rear stay 41 will be gradually increased. Thus, a support point of the front stay 12 supporting the panel 2 is caused to be raised or rendered higher relative to a supporting point of the rear stay 41 supporting the panel 2, with the result that, as shown in FIGS. 9 and 10, in the fully opened state of the panel 2, the rear stay 41 has a substantially horizontal position,

thus rendering the angle the panel 2 makes with the rear fixed roof 6 as small as possible. At this time, the panel 2 is firmly supported at both sides of the front end part thereof with the paired front stays 12 and at both sides of the intermediate part thereof with the paired rear stays 41.

During these rearward movements, the frame side sub-guide rails 31 are raised obliquely to tilt up the panel 2. As a result, the rear slide stays 41 themselves are elevated relative to the rear roof 6 so that the roots of the rear slide stays 41 can be brought close to the rear edge side in the roof opening 4 and so that the rear portions of said rear stays 41 can sufficiently extend rearwardly of the roof opening 4, i.e., to above the rear fixed roof 6. Thus, the longitudinal stroke of the panel 2 can be enlarged to elongate the roof opening 4.

Moreover, since the rear portions of the rear slide stays 41 can sufficiently extend rearwardly of the roof opening 4, the overhang length of the panel 2 when opened, i.e., the distance between the rear ends of the rear slide stays 41 and the rear end of the panel 2, can be shortened so that the supporting strength of the panel 2 when opened is enhanced.

On the contrary, to close the roof opening 4, when the cable actuator is operated to have the drive cable 26 move forwardly, the forward movement of the drive cable 26 will be transmitted through the front stay 12 to the panel 2, thereby causing the sliders 16, 43, 44, 45 to permit the panel 2 and the rear stay 41 to move forwardly so that, as shown in FIG. 8, the panel 2 is brought over the roof opening 4.

Then, when the tilt-up mechanism 36 drives the drive lever 37 to turn downwardly, the frame side sub-guide rail 31 will swing downwardly about the support shaft 35 as a fulcrum, thereby putting away the rear stay 41 and the frame side sub-guide rail 31 under the panel 2, to close the roof opening 4 with the panel 2.

In the above first embodiment of the invention, in which the sub-guide rail 31 has an arcuate form convexed upwardly, the distance between the front stay 12 and the rear stay 41 becomes smaller as the panel 2 slides over the rear fixed roof 6. Accordingly, the inclination of the panel 2 relative to the rear fixed roof 6 will be kept small to a considerable degree even in a modified example in which the frame side sub-guide rail 31 may be straight, assuming no more than that the rear stay 41 has its height predetermined to be smaller than the height of the front stay 12.

With respect to such example, a similar effect will be obtainable even in a further modification in which the height of the front stay 12 may be equal to or smaller than that of the rear stay 41, provided that the main guide rail 23 has its fixing position raised as a whole relative to the frame member 22.

Referring now to FIGS. 11 to 14 showing the sliding roof according to a second embodiment of the invention, a panel 2 is provided at both sides on the underside thereof with either of a pair of front guide rails 51 extending between the front part to the intermediate part of the panel 2 and a front stay 52 is slidably fitted between each front guide rail 51 and either of a pair of straight main guide rails 53. As shown in FIGS. 1, 11 and 12, the main guide rail 53 follows the slope of the vehicle roof and is, like the rail 23 in the first embodiment, slightly rearwardly inclined upwardly. The second embodiment is distinctive in these points from the first embodiment.

Each front guide rail 51 has a guide portion 54 formed therein with a guide slot 55, and the front stay 52 is provided with an upper slider 56 formed to be of substantially the same length as the front guide rail 51 and slidably fitted in the guide slot 55 of the front guide rail 55 as shown in FIG. 13. The front stay 52 is so formed as to extend forwardly from under the front end part of the upper slider 56 and is adapted, when closing the panel 2 to have its lower end part 58 put under a front fixed roof 15 of the vehicle, the lower end part 58 being provided with a slider 16, similar to that of the first embodiment, fitted in the main guide rail 53.

Moreover, the front stay 52 is adapted to be slidable between the front guide rail 51 and the main guide rail 53, thus rendering the length of the main guide rail 53 equal to the distance between the front part of a roof opening 4 to a substantially intermediate part thereof and the position thereof substantially parallel with a frame member 22. The frame member 22 is provided thereon, in its transversely inward part relative to the main guide rail 53, with a guide piece 61 for guiding a drive cable 26 which is secured at the end thereof to support piece 62 depending downwardly from the underside surface of the panel 2, thereby permitting the panel 2 to move longitudinally of the vehicle with the drive cable 26.

Further, the front stay 52 is so arranged that, when the roof opening 4 is closed with the panel 2, the lower slider 16 comes in the front end part of the main guide rail 53 and the upper slider 56 extends along substantially the total length of the guide slot 55 of the front guide rail 51. As shown in FIG. 12, in the state in which the panel 2 is moved over a rear fixed roof 6 of the vehicle, the lower slider 16 is located in the rear end part of the main guide rail 53 and the upper slider 56 is engaged at the rear end part thereof with an engagement portion (not shown) formed in the front end part of the front guide rail 51.

In this second embodiment, the lower and upper sliders 16, 56 and the main and front guide rails 53, 51 are so arranged that, with the longitudinal movement of the panel 2, the front stay 52 also moves longitudinally of the vehicle. Namely, the rearward movement of the front stay 52 may be such that at first only the panel 2 moves rearwardly from the state shown in FIG. 11 and in due course the upper slider 56 engages at the rear end part thereof with the engagement portion in the front end part of the front guide rail 51 before the front stay 52 starts moving rearwardly integrally with the panel 2, or such that the front stay 52 moves rearwardly integrally with the panel 2 from the initial point and in due course the lower slider engages with the rear end of the main guide rail 53 before the upper slider 56 slides along the front guide rail 51, thereby permitting only the panel 2 to move rearwardly. Further, the front stay 52 may move rearwardly, sequentially following the rearward movement of the panel.

Relative to the first embodiment of the invention, the above-described second embodiment thereof is similar in that, with the rearward movement of the panel 2, a rear stay 41 moves rearwardly guidedly with a frame side sub-guide rail 31 while being gradually inclined and, in the fully opened state of the panel 2, becomes substantially horizontal, thus rendering small the angle the panel 2 makes with the rear fixed roof 6, and the panel 2 is firmly supported at the front end part thereof and the intermediate part thereof with the front stay 52 and the rear stay 41, respectively. The second embodi-

ment is distinctive in that as well as the rear stay 41 the front stay 52 is also caused to slide, thus rendering the longitudinal movement of the panel 2 smoother and the length of the main guide rail 53 is rendered equal to the distance between the front part of the roof opening 4 to a substantially intermediate part thereof, thus enabling placement of the main guide rail 53 and the frame side sub-guide rail 31 on the same straight line, thereby permitting the width of the device at both sides of the roof opening 4 to be reduced, with resultant advantages such as the possible expansion of the opening width. As shown in FIGS. 11-14, the overall height of the front stay 52, including the upper slider 56 and the lower slider 16, is greater than the overall height of the rear stay 41, including the upper slider 43 and the unnumbered lower slider.

Referring now to FIGS. 15 to 19 showing the sliding roof according to a third embodiment of the invention, a pair of main guide rails 71 arcuately formed to be slightly convexed upwardly are arranged on a roof frame 22 so as to extend at both sides of a roof opening 4 from the front part of the roof opening 4 to the rear part thereof and adapted to be swingable with a tilt-up mechanism 36, thus eliminating frame side sub-guide rails, while in these points the third embodiment is different from the first embodiment.

Each main guide rail 71 has a guide portion 72 shaped in its section in the form of a channel defining a slot 73 directed transversely outwardly of the vehicle, in which slot 73 a slider 75 fixed to the lower end of a front stay 74 and a pair of sliders 77, 78 fixed to the lower end of a rear stay 76 are slidably fitted, respectively.

The main guide rail 71 is pivotably connected at its front end part 83 to a support shaft 82, which is supported with a hinge arm 81 secured to a frame member 22 at either side of the front part of the roof opening 4, and at the rear end part thereof through a support shaft 84 to a drive lever 37 of a tilt-up mechanism 36, and is adapted so as to vertically swing about the support shaft 82 as a fulcrum, following the drive lever 37, when lever 37 is driven to vertically turn by the tilt-up mechanism 36.

As shown in FIG. 18, in the main guide rail 71, at the transversely inward side of the guide portion 72, there is formed a guide slot 85 for slidably guiding a drive cable 26 similarly to the first embodiment, the drive cable 26 being fixed at the end thereof to a support piece 86 projected from either side of the front stay 74, thereby permitting the panel 2 to be longitudinally moved with the drive cable 26.

The front stay 74 is arranged such that, in a state in which the roof opening 4 is closed with the panel 2 as shown in FIG. 15, lower end part 88 comes under a front fixed roof 15 of the vehicle and slider 75 faces the front end part of the main guide rail and, when the panel 2 is moved over rear fixed roof 6 of the vehicle as shown in FIG. 17, the slider 75 is brought near the rear end part of the main guide rail 71.

Moreover, the main guide rail 71, roof slide sub-guide rail 31 and sliders 43, 77, 78 are arranged such that the rear stay 76 is longitudinally movable with the longitudinal movement of the panel 2. The sliders 77, 78 fixed to the lower end of the rear stay 76 are adapted so as to be located, in the state in which the roof opening 4 is closed with the panel 2, substantially at the intermediate part of the main guide rail 71. In the state in which the panel 2 is moved over the rear fixed roof 6, the rear stay 76 has its rearward extension 89 positioned over the rear

fixed roof 6 and the lower rear slider 78 faces the rear end part of the main guide rail 71.

With respect to the first embodiment of the invention, the foregoing third embodiment thereof is similar in that, with the rearward movement of the panel 2, the rear stay 76 moves rearwardly guidedly with the main guide rail 71 while being gradually inclined and, in the fully opened state of the roof opening 4, becomes substantially horizontal, thus rendering small the angle the panel 2 makes with the rear fixed roof 6, and the panel 2 is firmly supported at the front end part thereof and the intermediate part thereof with the front stay 74 and the rear stay 76, respectively. The third embodiment is distinctive in that no more than the main guide rail 71 is provided as a frame side guide rail, thus effecting the simplification such as in the manufacture and assembly work and favorably shortening the transverse width of the sliding roof devices disposed on both sides of the roof opening 4, thereby rendering such devices compact and enabling the opening size to be increased.

In the third embodiment of the invention, as the panel 2 slides over the rear fixed roof 6, the distance between the front stay 74 and the rear stay 76 becomes smaller. Therefore, the inclination of the panel 2 relative to the rear fixed roof 6 will be kept small even in a modified example in which the main guide rail 71 may be straight, provided that the front stay 74 has a height greater than that of the rear stay 76.

As is apparent from the foregoing description, according to the present invention it is possible to retain the longitudinal stroke of the panel at a large value and to enhance the supporting strength of the panel in an opened state.

What is claimed is:

1. An apparatus for tilting up a sliding roof panel (2) about a rear edge of a frame (22) defining an opening (4) in a vehicle roof (6, 15) and for moving said sliding roof panel (2) rearwardly, said apparatus comprising:

guide means (23, 31, 53, 31, 71) arranged on both sides of said opening (4); and

stay means, including front stays, (12, 52, 74) and rear stays (41, 41, 76), provided on said sliding roof panel (2);

said sliding roof panel (2) is supported at a front end thereof by said front stays (12, 52, 74) provided on both sides thereof and at a rear end thereof by said rear stays (41, 41, 76) provided on both sides thereof;

at least said rear stays (41, 41, 76) being supported by portions of said guide means (31, 31, 71), front ends of said portions (31, 31, 71) being hinged to said frame (22) and rear ends of said portions (31, 31, 71) being liftable;

said rear stays (41, 41, 76) being elevated when the rear ends of said portions (31, 31, 71) are lifted; and each of said rear stays (41, 41, 76) having a rearwardly extending section which, when said sliding roof panel (2) has been completely moved rearwardly, is located over a section (6) of said vehicle roof (6, 15) adjacent a rear edge of said opening (4).

2. The apparatus of claim 1, wherein: the height of said front stays (12, 52, 74) is greater than that of said rear stays (41, 41, 76).

3. The apparatus of claim 1, wherein: said guide means include guide rail means (23, 53) fixed to said frame (22) and guide rail means (31, 31) hinged to a front portion of said frame (22) and liftable at a rear end thereof; and

said front stays (12, 52) are guided in said fixed guide rail means (23, 53), and said rear stays (41, 41) are guided in said hinged guide rail means (31, 31).

4. The apparatus of claim 2, wherein: said guide means include guide rail means (23, 53) fixed to said frame (22) and guide rail means (31, 31) hinged to a portion of said frame (22) and liftable at a rear end thereof; and

said front stays (12, 52) are guided in said fixed guide rail means (23, 53), and said rear stays (41, 41) are guided in said hinged guide rail means (31, 31).

5. The apparatus of claim 3, wherein: said fixed guide rail means (23, 53) are rearwardly inclined upwardly.

6. The apparatus of claim 4, wherein: said fixed guide rail means (23, 53) are rearwardly inclined upwardly.

7. The apparatus of claim 1, wherein, said front stays (12, 74) are fixed to said sliding roof panel (2) and said rear stays (41, 76) are slidably connected to said sliding roof panel (2).

8. The apparatus of claim 2, wherein: said front stays (12, 74) are fixed to said sliding roof panel (2) and said rear stays (41, 76) are slidably connected to said sliding roof panel (2).

9. The apparatus of claim 3, wherein: said front stays (12) are fixed to said sliding roof panel (2) and said rear stays (41) are slidable at said sliding roof panel (2).

10. The apparatus of claim 4, wherein: said front stays (12) are fixed to said sliding roof panel (2) and said rear stays (41) are slidably connected to said sliding roof panel (2).

11. The apparatus of claim 5, wherein: said front stays (12) are fixed to said sliding roof panel (2) and said rear stays are slidably connected to said sliding roof panel (2).

12. The apparatus of claim 6, wherein: said front stays (12) are fixed to said sliding roof panel (2) and said rear stays (41) are slidably connected to said sliding roof panel (2).

13. The apparatus of claim 3, wherein: said fixed guide rail means (23, 53) are straight and said hinged guide rail means (31, 31) are upwardly arcuate.

14. The apparatus of claim 4, wherein: said fixed guide rail means (23, 53) are straight and said hinged guide rail means (31, 31) are upwardly arcuate.

15. The apparatus of claim 5, wherein: said fixed guide rail means (23, 53) are straight and said hinged guide rail means (31, 31) are upwardly arcuate.

16. The apparatus of claim 6, wherein: said fixed guide rail means (23, 53) are straight and said hinged guide rail means (31, 31) are upwardly arcuate.

17. The apparatus of claim 11, wherein: said fixed guide rail means (23) are straight and said hinged guide rail means (31) are upwardly arcuate.

18. The apparatus of claim 12, wherein: said fixed guide rail means (23) are straight and said hinged guide rail means (31) are upwardly arcuate.

19. The apparatus of claim 1, wherein: said front stays (74) and said rear stays (76) are guided in said portions of said guide means (71), and said portions of said guide means (71) are hinged to a front end of said frame (22), and are upwardly arcuate and liftable at a rear end thereof.

20. The apparatus of claim 2, wherein: said front stays (74) and said rear stays (76) are guided in said portions of said guide means (71), and said portions of said guide means (71) are hinged to a front end of said frame (22), and are upwardly arcuate and liftable at a rear end thereof.

21. The apparatus of claim 19, wherein: said portions of said guide means (71) are arcuately formed to be slightly convexed upwardly.

22. The apparatus of claim 1, wherein: said front and rear stays (52, 41) are slidably connected to said sliding roof panel (2).

23. The apparatus of claim 19, wherein: said front stays (74) are fixed to said sliding roof panel (2) and said rear stays (76) are slidably connected to said sliding roof panel (2).

* * * * *

45

50

55

60

65

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 4,690,452
DATED : September 1, 1987
INVENTOR(S) : Toshiaki NIWA

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 3, line 32, change "One" to --on--.,
Column 6, line 6, change "55" to --51--.
Column 8, line 20, correct the spelling of --opening--.
Claim 11, line 3, (column 9, line 36), after "stays"
insert --(41)--.

Signed and Sealed this
Twenty-ninth Day of March, 1988

Attest:

DONALD J. QUIGG

Attesting Officer

Commissioner of Patents and Trademarks